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EFFECTS OF DIFFERENT LEVELS OF PHOSPHORUS ON THE GROWTH AND YIELD OF MAIZE *(Zea mays l.*) IN OFERE (BASEMENT COMPLEX) SOILS KOGI STATE, NORTH CENTRAL ECOLOGICAL ZONE, NIGERIA

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ABSTRACT
In southern guinea savanna of Nigeria, where ofere belongs, the soils are inherently low in P because of the dry nature of the climate, low vegetation cover and generally sandy nature of the soil, whose clay mineralogy is dominated by inactive kaolinite materials. This study was undertaken in Ofere, Kogi State, Nigeria to investigate the response of maize crop to addition of varying rates of phosphorus. The trial, a Randomized Complete Block Design (RCBD) involves seven rates of P (0, 20, 40, 60, 80, 100 and 120kg/ha) applied as single super phosphate (SSP) for P calibration. The soils of the area were analyzed for physical and chemical properties prior to imposition of treatment. In the field calibration studies, optimum maize grain yield of 3.93 and 4.86 ton/ha were obtained for 2007 and 2008 cropping season, respectively from the application of 120kg P/ha. Application of 120kg P/ha is therefore recommended for maize production in soils of Ofere, Kogi State of Nigeria.

KEY WORDS: Basement Complex, phosphorus, cropping system, calibration.

INTRODUCTION

Phosphorus is one of the major elements and it is second in importance to nitrogen in terms of nutrient requirement for increased crop production in most tropical soils. The beneficial effect of phosphorus fertilizer application had been widely documented (Nguu, 1987; Ragi *et al*., 2001). It is generally recognized as one of the major elements essential to the well being of all plants with its deficiency constituting a serious limitation to crop production in most weathered soils with high Fe and Al oxides that quickly fix added P (Uyovbisere, 1994). It is a major constituent of nucleic acid, phytin and phospholipids and is considered to be especially importance in stimulating early growth in the development of reproductive parts and vigorous root systems of all higher plants. Although, phosphorus occurs in most plants in much smaller quantities than other two major nutrient elements, N and K, it is widely used in the fertilization of agricultural crops because most cultivated soils cannot meet the demand of rapidly growing annual crops (Prictchett, 1978)

Previous studies had shown that soils deficient in P and having high P-fixing capacity, irrespective of soil P, responded to P rates and liming (NRCRI, 1977). Buckman and Brady (1969) after considering the significant avenue of P loss concluded that P problems are due to the following: (i) low total amount in soils. (ii) unavailable native P and (iii) retention of added P, which subsequently leads to inefficient P-utilization. Plants suffering from phosphorus deficiency are retarded in growth and the shoot/root dry matter ratio is usually low. In cereal, tillering is affected, fruit trees show reduced growth rates of new shoot and frequently the development and the opening of buds is unsatisfactory. There is premature leaf fall, purple or red anthomyacin pigmentation and the development of dead necrotic areas on the w the deficiency symptoms before the young leaves (Mengel and Kirby, 1987; Bame, 1998; Ochi *et al*., 2002). Omoregie (1999) studied the effect of phosphorus application on *verano Stylosanthus hema* and *Centrosema pascuorum* under sub-humid conditions in Nigeria. He observed a significant effect on dry matter production and seed yield with increase in P application. He also observed that the application of 40 kgP/ha was best for optimum production of *Centrosema pascuorum* while 60 kgP/ha was best for the production for the legumes. In the savanna soils of Mokwa, *Kogbe et al*. (2003) reported that control plot (0 kg P_2O_5) gave the least yield of maize

when compared to other rates. A steady increase in grain yields to 3.5 ton/ha of the hybrid maize was obtained when up to 60kgP/ha was applied. An early trial with P fertilizer indicated that 11kgP/ha was the optimum rate of phosphate fertilization in the savanna zone of Nigeria. However, recent experiments had shown that improved grain varieties responded to 33 kgP/ha (Dougherty *et al*., 2004). The latest fertilizer recommendation is 21 kgP/ha (Elkased and Nnadi, 1987).

In southern guinea savanna of Nigeria, where ofere belongs, the soils are inherently low in P because of the dry nature of the climate, low vegetation cover and generally sandy nature of the soil, whose clay mineralogy is dominated by inactive kaolinite materials (Uyovbisere, 1994). It is consequently recognized that profitable cropping is only possible where soil fertility is adequately maintained (Lombin, 1987; Sinang, *et al*., 2002). With increasing pressure on soils of southern guinea savanna agro ecological zone, shifting cultivation is no longer sustainable and traditional bush fallow period for maintaining the productivity of the soil has become shorter; soils are no longer able to supply the quantity of nutrients required and as a result, yield level declines rapidly once cropping commences. Although phosphorus had been reported to be the most limiting nutrient to crop production in Northern Nigeria (Yusuf and Yusuf, 2008), however, there is scarcity of information as regards P status in soils of Ofere in the Guinea Savanna of Kogi State, Nigeria. The objective of this study was to determine the effects of different levels of phosphorus fertilizer on the growth and yield of maize in soils of Ofere.

MATERIALS AND METHODS

Location of Study Areas

Ofere lies between longitude 7^0 25^1 to 5^0 46^1 N and latitude 7^0 46^1 and 5^0 44^1 east of the equator and their main occupation is farming. It has a bimodal rainfall with the peak pattern occurring in July and September with a mean annual rainfall of 132.00 mm. Rainfall is distributed from March to November with most rains in occurring in July and again in September and October. The dry season generally extends from November to March. During this period, rainfall drops drastically to less than 12.00 mm in any of the months. Temperature shows some variation throughout the year with average monthly temperature varying from 17 ^{0}C to 33.3 ^{0}C. Relative humidity is moderately high and varies from an average of 65 - 85% for most part of the year. The main vegetation is the forest savanna mosaic zone. The geology of the area is Basement complex Soils. Composite surface soil samples (0 - 15 cm), were collected from pre-classified sites (FDALR, 1985) for soil analysis. The soil samples were air dried, crushed with the aid of wooden roller and sieved through 2 mm sieve then stored in sealed plastic container for subsequent use. Particle size was determined by hydrometer method (Gee and Bauder, 1986). Soil pH was measured in a soil: water ratio of 1:1 with the aid of glass electrode pH meter (Maclean, 1982). Organic matter was determined by wet dichromate acid oxidation method (Nelson and Sommers, 1982). Exchangeable bases (Ca, Mg, K and Na) were extracted with 1N NH_4OAC buffered at pH 7 (Thomas, 1982). Ca and Mg was determined using atomic absorption spectro photometer, while K and Na were read on flame photometer. Exchange acidity was extracted with 1N KCL (Thomas, 1982) and determined by titration with 0.05N NaOH using phenolphthalein as indicator. Nitrogen was determined by Macro Kjedahl method (Bremmer and Mulvany, 1982). Effective cation exchange capacity (ECEC) was calculated by the summation exchangeable bases (Ca, Mg, K and Na) and exchange acidity (Carter, 1993). Extractable micronutrients (Mn, Fe, Zn and Cu) were determined by double acid method. Total phosphorus was determined by per-chloric acid ($HCLO_4$) digestion method (Murphy and Riley, 1962). Organic phosphorus was determined by ignition method (Legg and Black, 1955). Available P was estimated by Bray P-1 (Bray and Kurtz, 1945) (Table 1).

Field Calibration Studies:

The field experiments spanned two years: 2007 and 2008 cropping season. The experiments were conducted using randomized complete block design with three replications (RCB). The experimental plot size used was 3.00 m x 1.75 (5.25 m^2) and the entire experimental area was 15.25 m x 11 m (167.75 m^2). Maize variety, Downey mildew resistant (DMRT) from IAR&T Ibadan was used for the experiment and the spacing adopted was 75 cm by 25 cm. This was manually planted (three seeds per hole) at 3 - 5cm depths. The seedlings were thinned down to one plant per stand two weeks after crop emergence. There were a total of 28 stands of maize plants in each plot, 196 stands in a block giving a plant population of 588 plants on the entire experimental site. Seven different levels of single super phosphate (SSP) fertilizer were applied at the following rates 0, 20, 40, 60, 80, 100 and 120 kgP/ha coded P_0, P_1, P_2, P_3, P_4, P_5, P_6, respectively. Nitrogen and potassium were below critical levels; hence urea and muriate of potassium

were used to raise them above the critical levels before planting was done. The fertilizers were mixed properly and applied banded on one side of the maize seeds using groove of 10 cm wide and 10 cm deep and 8 cm away from the seeds. The experimental plots were manually weeded by hoeing and by hand weeding as required. Before planting in the fields, composite surface soil samples were collected from each the experimental sites and analyzed for their physico-chemical properties. The following agronomic traits, number of leaves, plant height, stem girth, leaf area were measured at 2, 4, 6, 8 and 10 weeks after planting. For the yield, only 4 plants at the two middle rows were harvested from the 28 plants in each plot to eliminate the effects of cross feeding and yield was computed per hectare based on the area of the harvested cobs. The harvested cobs were de-husked, weighed, threshed weighed again and the grain yield adjusted to 13% moisture content. Maize agronomic traits and yields were subjected to statistical analysis. Mean comparisons were carried out using least significant differences (LSD) test only when F-value was significant.

RESULTS AND DISCUSSION

Analyzed results showed that except in 2007 where phosphorus application had no significant effect on maize height at 2WAP it significantly influenced plant height at other times of data collection: 4, 6, 8 and 10WAP for 2007 and at 2, 4, 6, 8 and 10WAP in 2008. Maize crop significantly increased in height over the control with increase in P application (Table 2a). In 2007 at 4WAP, only the application of 20 KgP/ha increased plant height significantly when compared to the control. At 6, 8 and 10WAP, application of phosphorus resulted in plant heights that were significantly taller than the control. Application of 120 kgP/ha gave the highest plant height of 161.67 cm and 174.33 cm at 6 and 8 WAP, respectively when compared to 62.83 and 96.33cm obtained from the controls. But at 10WAP, the application of 100 KgP/ha gave the highest maize plant height of 198.15 cm in comparison to 124.33 cm obtained from the control. In 2008, the trend was generally different when compared to the results obtained in 2007 (Table 2b). At 2WAP and 4WAP, the effect of phosphorus fertilizer application on maize plant height showed similar trend. The application of 20 and 120 KgP/ha significantly gave the highest maize plant height of 44.73 and 76.83 cm when compared to 25.50 and 45.83 cm obtained from the control in 2 and 4WAP, respectively. The trends at 6, 8 and 10WAP were generally different. At 6WAP, though all the fertilizer levels gave higher maize plant height when compared to the control, the application of 120 KgP/ha was significantly better than mean maize plant height obtained from the application of 20, 40 KgP/ha and the control. Application of 120 KgP/ha gave the highest mean maize plant height of 91.33 cm when compared to 56.50 cm obtained from the control. At 8 and 10 WAP, application of 80, 100 and 120 kgP/ha significantly gave higher maize plant height when compared to the control. The highest mean plant height of 105.50 cm and 119.17 cm were obtained from the application of 80 and 120 kgP/ha relative to 67.50 and 73.17 obtained from the control in 8 and 10WAP, respectively

The mean maize leaf area was significantly affected by phosphorus fertilizer application in 2007 (Table 2b). At 2WAP, application of 120kgP/ha significantly gave the highest maize leaf area of 1335.96 cm when compared to 657.60 cm obtained from the control (Table2b). However, the lowest leaf area was obtained from the application of 60 kgP/ha. At 4 and 6WAP the application of 120 kgP/ha significantly enhanced leaf area, it gave leaf area of 4429.16 and 4969.18 cm^2 when compared to the lowest leaf area of 780.24 and 809.24 cm^2 obtained from the controls. At 8WAP, application of all levels of P fertilizer except 20 and 40 kgP/ha significantly gave higher maize leaf area when compared to the control. The highest leaf area of 5394.52 cm^2 was obtained from the application of 120kgP/ha. At 10WAP, similar trend was observed.

In 2008, application of 120 kgP/ha gave the highest leaf area at 2, 4 and 6WAP; it gave 1458.84, 1489.62 and 4633.22 cm^2, respectively (Table 2b). However, at 2WAP, application of 60 kgP/ha gave significantly lower maize leaf area when compared to the control. At 8 and 10WAP, the trend was different, application of 100 kg/ha gave the highest leaf area of 4121.18 and 4592.08 cm^2 when compared to 1446.68 and 1690.80 cm^2 that what were obtained from the control. In 2007, maize stem girth was generally significantly better than the control in all the weeks after planting (Table 3a). At 2WAP, maize stem girth was significantly higher than the control with all the levels of P fertilizer application except with 20 and 40 kgP/ha. But at 4WAP, 80 and 120 kgP/ha gave the highest stem girth of 6.00 and 6.67 cm when compared to 4.00 cm obtained from the control. At 6WAP, the result obtained showed similar trend from what was obtained at 2WAP and was only significantly different from 20, 40 kgP/ha and the control, respectively. At 8 and 10WAP the effects of the application of 60, 80, 100 and 120 kgP/ha on maize stem girth was not significantly different from one another but different from that obtained from the control. The

application of 120KgP/ha gave the highest stem girth in all the weeks after planting. The application of 120 KgP/ha in soils, in all the weeks after planting gave the highest maize stem girth (Table 3a) in 2008. At 2WAP, the application of 60, 100 and 120 kgP/ha resulted in significant high stem girth when compared to what was obtained from the control and what were obtained from the application of 20, and 40 KgP/ha. But at 4WAP, all P fertilizer applications resulted in higher stem girths that were higher than the control. Similar trends were observed at 6, 8 and 10WAP, respectively.

In 2007, all P treatments effects on number of leaves at 2WAP were generally better than the control (Table 3b). At 4WAP, the application of 20, 40 and 120 kgP/ha significantly gave higher number of leaves of 8.00, 7.83 and 8.00 cm when compared to 6.00 cm obtained from the control. At 6, 8 and 10WAP, application of P resulted in number of leaves that were significantly better than the control. The highest numbers of leaves of 10.33 and 11.67cm were obtained from the application of 100 to 120 kgP/ha and 60kgP/ha in 6 and 8WAP, respectively while at 10WAP, all the rates of phosphorus application gave numbers of leaves that were better than that obtained from the control. In 2008, the effect of applied phosphorus in Ofere soils on number of leaves did not show any definite trend at 2WAP (Table 3b). Application of 40 KgP/ha resulted in the highest number of leaves when compared to the control. At 4 and 6WAP, maize responses to P fertilizer in terms of number of leaves was highest when 120 kgP/ha was applied. At 8 and 10WAP, the trends were similar in all the levels of P application. The highest number of leaves were obtained from the application of 120 and 100 kgP/ha and both were not significantly different from each other.

In 2007 cropping season, the highest cob weight of 4.68 ton/ha was obtained from the application of 100 and 120 kgP/ha, these were not significantly different from what resulted from the application of 60 and 80 kgP/ha, respectively. Optimum maize grain yield of 3.93ton/ha was obtained from the application of 120kgP/ha (Table 4). In 2008, the highest cob weight of 6.09 ton/ha was also obtained from the application of 120 kgP/ha. Optimum grain yield of 4.86 ton/ha was obtained from the application of 120 kgP/ha. Relative yields of 22.7% and 29.5% were obtained for 2007 and 2008 in Ofere location, respectively (Table 4). These findings were in agreement with what Kogbe and Adediran (2003) reported. They earlier reported a steady increase in grain yields of maize as P application increases. They obtained grain yield of 3.50 ton/ha from the application of 60 kgP/ha. However, they laid emphasis on P and N application. These findings were at variance with what was reported by some other workers, who suggested lower levels of P application (Irving, 1956., Elkased and Nnadi, 1987). Enwezor (1979) had earlier criticized the low P application recommended by Irving (1956) and Igbokwe *et al* (1981) and questioned the validity of the general P fertilizer application of less than 18kgP/ha.

Table 1: Physical and chemical properties of soils used for study

% Clay	% Silt	% Sand	Textural Class	pH (H_2O)	g/kg OM	g/kg N	Mg/kg	← Cmol/kg						→	Al_{203}	Fe_{203}
								Ca	Mg	Na	K	H^+	Al	ECEC	→ g/kg ←	
5.90	10.00	84.10	Loamy sand	5.89	14.50	1.00	10.31	10.40	3.30	0.84	0.18	0.20	0.20	15.19	18.50	21.50

Table 2a: Effect of phosphorus application on maize plant height (cm^2) in Soils of Ofere

2007						2008					
Treatments P(kg/ha)	2WAP	4WAP	6WAP	8WAP	10WAP	Treatments P(kg/ha)	2WAP	4WAP	6WAP	8WAP	10WAP
0	24.50ns	47.83^{b}	62.83^{c}	96.33^{b}	124.33^{b}	0	25.50^{b}	45.83^{b}	56.50^{c}	67.50^{b}	73.17^{c}
20	38.17ns	76.67^{a}	130.00^{ab}	155.67^{a}	180.33^{a}	20	44.73^{a}	70.17^{a}	71.17^{bc}	87.50^{ab}	92.17^{bc}
40	29.66ns	60.83^{ab}	105.33^{ab}	162.67^{a}	184.83^{a}	40	40.87^{ab}	63.88^{ab}	75.17^{abc}	89.17^{ab}	98.17^{abc}
60	27.67ns	56.33^{ab}	137.33^{b}	173.88^{a}	194.15^{a}	60	34.53^{ab}	59.17^{ab}	70.33^{abc}	81.50^{ab}	91.50^{bc}
80	32,00ns	62.33^{ab}	148.67^{a}	174.00^{a}	187.17^{a}	80	39.18^{ab}	68.53^{ab}	87.17^{ab}	105.50^{a}	118.83^{a}
100	23.17ns	57.17^{ab}	130.00^{ab}	168.33^{a}	198.15^{a}	100	29.82^{ab}	68.17^{ab}	81.83^{abc}	96.83^{a}	114.17^{ab}
120	34.73ns	64.33^{ab}	161.67^{a}	174.33^{a}	185.67^{a}	120	42.15^{a}	76.83^{a}	91.33^{a}	103.17^{a}	119.17^{a}

Means within the same vertical column followed by the same small letter (s) are not significantly different at 5% level of probability.

Table 2b: Effect of phosphorus application on maize leaf area (cm^2) in Soils of Ofere

2007						2008					
Treatments P (kg/ha)	2WAP	4WAP	6WAP	8WAP	10WAP	Treatments P(kg/ha)	2WAP	4WAP	6WAP	8WAP	10WAP
0	657.6^{bc}	780.24^{c}	809.24^{c}	1417.40^{c}	1560.88^{b}	0	641.40^{bc}	866.58^{b}	1402.20^{c}	1446.68^{c}	1690.86^{d}
20	1033.20^{ab}	2921.98^{b}	3227.68^{b}	3334.52^{abc}	3251.98^{ab}	20	1096.80^{abc}	1344.76^{ab}	3722.60^{ab}	3588.95^{b}	3829.36^{bc}
40	705.62^{abc}	2693.04^{b}	2831.12^{b}	3005.70^{bc}	3473.13^{ab}	40	630.24^{abc}	1355.54^{ab}	3468.70^{b}	3527.56^{b}	3669.36^{abc}
60	371.76^{c}	3442.36^{b}	3174.30^{b}	3370.10^{ab}	3633.20^{a}	60	603.30^{c}	812.44^{b}	3478.70^{ab}	3750.70^{ab}	3906.58^{abc}
80	625.44^{bc}	3128.2^{b}	3454.84^{b}	3696.74^{ab}	3784.34^{a}	80	746.46^{ab}	864.36^{b}	3853.70^{ab}	3933.11^{ab}	3954.40^{abc}
100	1148.76^{ab}	4243.20^{a}	4709.71^{a}	5130.50^{ab}	5595.92^{a}	100	1347.60^{ab}	1381.94^{ab}	4205.30^{ab}	4421.18^{a}	4592.08^{a}
120	1335.96^{a}	4429.46^{a}	4969.18^{a}	5394.52^{a}	5674.46^{a}	120	1458.84^{a}	1489.62^{a}	4633.22^{a}	4837.20^{a}	4991.22^{ab}

Means within the same vertical column followed by the same small letter (s) are not significantly different at 5% level of probability.

Table 3a Effect of phosphorus application on maize stem (cm^2) girth in soils of Ofere

2007

Treatments P(kg/ha)	2WAP	4WAP	6WAP	8WAP	10WAP
0	3.22^{d}	4.00^{ab}	4.42^{c}	5.02^{b}	5.60^{b}
20	4.17^{cd}	5.58^{ab}	5.77^{bc}	5.88^{b}	6.67^{b}
40	4.23^{cd}	5.30^{ab}	5.75^{bc}	6.22^{b}	6.61^{b}
60	4.82^{bc}	5.50^{ab}	7.17^{ab}	8.17^{a}	8.75^{a}
80	5.43^{bc}	6.00^{a}	6.90^{ab}	8.18^{a}	9.13^{a}
100	5.87^{ab}	5.93^{ab}	7.13^{ab}	8.23^{a}	9.10^{a}
120	6.58^{a}	6.67^{a}	8.50^{a}	9.58^{a}	10.32^{a}

2008

Treatments P(kg/ha)	2WAP	4WAP	6WAP	8WAP	10WAP
0	3.23^{e}	3.83^{d}	4.25^{c}	4.53^{c}	4.78^{c}
20	4.00^{de}	5.32^{c}	5.00^{b}	6.45^{b}	7.22^{b}
40	4.05^{de}	5.68^{c}	6.29^{b}	6.87^{b}	7.60^{b}
60	5.02^{cd}	5.65^{c}	6.15^{b}	6.65^{b}	7.37^{b}
80	5.67^{bc}	6.57^{bc}	7.15^{b}	7.88^{b}	8.48^{b}
100	6.72^{ab}	7.83^{ab}	8.67^{a}	9.62^{a}	11.03^{a}
120	7.27^{a}	8.47^{a}	9.25^{a}	10.25^{a}	12.75^{a}

Means within the same vertical column followed by the same small letter (s) are not significantly different at 5% level of probability.

3b: Effect of phosphorus application on maize number of leaves in soils of Ofere

2007

Treatments p(kg/ha)	2WAP	4WAP	6WAP	8WAP	10WAP
0	4.33^{c}	6.00^{b}	6.03^{b}	6.33^{b}	7.00^{b}
20	6.67^{ab}	8.00^{a}	9.00^{a}	10.83^{a}	11.67^{a}
40s	6.67^{ab}	7.83^{a}	8.50^{a}	11.17^{a}	12.33^{a}
60	6.00^{b}	7.33^{ab}	9.50^{a}	11.67^{a}	12.33^{a}
80	6.50ab	7.40^{ab}	9.50^{a}	11.17^{a}	12.33^{a}
100	5.01^{b}	7.17^{ab}	10.33^{a}	11.00^{a}	11.83^{a}
120	7.50^{a}	8.00^{a}	10.33^{a}	11.00^{a}	12.33^{a}

2008

Treatment p(kg/ha)	2WAP	4WAP	6WAP	8WAP	10WAP
0	1.53^{c}	6.50^{e}	7.83^{e}	8.50^{d}	8.83^{d}
20	6.83^{ab}	8.33^{bc}	9.83^{cd}	10.83^{b}	11.00^{b}
40	7.83^{a}	9.17^{c}	10.17^{c}	11.33^{b}	11.67^{b}
60	6.00^{bc}	7.33^{ed}	8.83^{de}	9.83^{c}	9.83^{c}
80	6.33^{ab}	8.83c^{bc}	9.83^{cd}	10.83^{b}	11.50^{b}
100	7.00ab	9.50^{b}	11.33^{b}	13.67^{a}	14.00^{a}
120	7.17^{ab}	11.00^{a}	12.67^{a}	14.33^{a}	14.00^{a}

Means within the same vertical column followed by the same small letter (s) are not significantly different at 5% level of probability

Table 4: Effect of Phosphorus on cob weight and grain yield (ton/ha) in soils of Ofere

2007			2008		
Treatments (kgP/ha)	Cob-wt (ton/ha)	Grain yield (t/ha)	Treatments (KgP/ha)	Cob-wt (t/ha)	Grain yield (t/ha)
0	2.01^{b}	0.89^{d}	0	2.23^{b}	1.43^{d}
20	2.66^{b}	1.41^{d}	20	5.00^{a}	2.34^{cd}
40	2.75^{b}	1.63^{cd}	40	4.90^{a}	2.18^{cd}
60	4.13^{a}	2.38^{bc}	60	5.94^{a}	2.73^{bcd}
80	3.79^{a}	2.74^{b}	80	5.94^{a}	3.23^{ab}
100	4.68^{a}	2.88^{b}	100	6.09^{a}	3.58^{bc}
120	4.68^{a}	3.93^{a}	120	5.50^{a}	4.86^{a}
LSD	0.97	0.93		2.25	1.04

Relative yield = 22.7% Relative yield = 22.50%

Means within the same vertical column followed by the same small letter(s) are not significantly different at 5% of level of probability.

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